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Research paper

Higher education selection using simple additive weighting

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Abstract

The process of selecting a college should be based on the capabilities and needs of the community. When society is faced with a large selection of college criteria and most societies are confused about choosing the appropriate college for themselves and the job demands. From this it was made a decision support system aimed at helping the community to choose a college that suits the ability and demands of the work. Decision support system plays a role in helping people get the right recommendations in the selection of universities. This decision support system is also designed to help the community to choose a college that suits their needs so that the public is not confused because of the many criteria of universities faced by the community because the admin already has recommendations according to the needs of the community by using Simple Additive Weighting (SAW) method.

Keywords: *Higher Education; Student; Simple Additive Weighting.*

1. Introduction

1.1. Background

In Indonesia, the number of universities continues to experience growth both public and private class. The growth of several universities in Indonesia indicates that the importance of knowledge gained for the provision of life or to find a job [1-3]. The looking view with visibility every year seems significant to elucidate the core point in enabling the number of students to get easily in continuing their learning enhancement [4-6]. In Indonesia, the number of education intuition has known three levels which needs to fulfill the requirements [7-9]. In order to access the learning enhancement among the learners, there should be underlined in giving insights into following the compulsory programs offered through the number of initiatives [10-12]. It is necessary to look into the model of compulsory education program one of which is Nine years [13-15]. It includes six years in Elementary School (SD), three years in Junior High School (SMP), and three years in High School or Vocational High School (SMK), although only required by Nine school year many students who continue to college level.
In addition, the main issue would be viewed into the way in making decision experienced by high school students in determining the selection of majors in the world of education for example in the determination of majors in universities [16-18]. The particular attention with accessing both cooperative and competitive alliance would need to enhance to give insights into performance value [19-21]. This initiative is entirely a particular concern in preventing the valuable insights towards the lack of information about the particular information from wide range of objects including department and students [22-24]. It refers to the commitment with awareness towards interests, talents and abilities in enabling them to determine their majors based solely on parental choice through following the course [25-27]. Attempts to particularly choose the encouragement with knowing the department itself should do with preparing to tackle the difficulties [28-30]. Feeling with enabling the wide range of lessons learned to follow refers to expand the particular direction which could consequently be expanded into undergoing lectures more effective [31-33]. However, the number of challenges could be viewed such as lazy, unserious effort, and thus it is necessary to avoid needed system, which could assist the students in solving problems in determining the majors in accordance with the interests and specified criteria [34-36].
In line with elucidating the selection of the best colleges, it is necessary to get access in obtaining the interactive system with incorporating the basis of needs and interests among the students [37-39]. The wide range of getting the desired criteria refers to obtain the quality of results and maximum learning [40-42]. Attempts to assist to maximize the decision support system become a pivotal value to deliver the interactive portion towards decision makers in giving update about particular information [43-45].
The model used in this decision support system model is SAW, because SAW is chosen because it can determine the weight value for each attribute, then proceed with the selection process which will select the best alternative from the number of alternatives, in this case the alternative is the best university based on the criteria specified.

1.2. Problem formulation

Based on the background of the above problem then the formulation of the problem are:

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1) How to determine criteria for university selection for the community?
2) How is the application of the Simple Additive Weighting (SAW) method to the decision support system to determine the college for the community?

1.3. Boundaries

In order that the discussion does not deviate from the underlying problems that have been formulated, there may be limitations as follows:

1) Criteria that become priority in determining Higher Education are academic achievement, lecturer, extracurricular, accreditation status, facility availability, campus scholarship.
2) The method used is Simple Additive Weighting (SAW)
3) The decision support system determines the best university.
4) This discussion is carried out only to discuss the selection of the best university election for the community.

1.4. Aims

The purpose of this study is to applying SAW method in determining university based on criteria and increasing knowledge about Simple Additive Weighting method.

1.5. Benefits

As for the benefits provided in this research is:

1) Make it easier in determining the best college for the community.
2) As a useful information for the community in its application.
3) Minimize the time in doing determine college selection.

2. Literature review

2.1. Decision support system

The significant effort to expand taking a good decision should be widely engaged into the several stages of the process within decision-making [46-48]. The decision process goes through the following steps:

1) Stage of understanding (Intelligence Phase) This stage is the process of tracking and detecting the scope of problematic and problem recognition process. The input data is obtained, processed and tested in order to identify the problem.
2) Design Phase (Design Phase)

In this stage the decision maker finds, develops and analyzes all possible solutions through modeling that can represent the real conditions of the problem. From this stage obtained the output of alternative document solutions. a) Phase of Choice (Choice Phase). In this stage the decision maker chooses one of the alternative solutions made at the design stage which is seen as the most appropriate action to overcome the current problem. From this stage obtained the solution documents and implementation plan. b) Implementation Phase (Implementation Phase). The decision maker runs the selected split action sequence at the choice stage. Successful implementation is marked by the answer to the problem faced, while the failure is marked still a problem that is being tried to overcome. From this stage obtained report on the implementation of the solution and the results.

Limitations of DSS are as follows:

1) There are some management abilities and human talents that can not be modeled, so the models that exist in the system do not all reflect the real problem.
2) The ability of a DSS is limited to the knowledge base it possesses (basic knowledge and basic model).
3) The processes that can be performed by DSS usually depend on the ability of the software it uses.

Multiple Attribute Decision Making (MADM) is a method used to find the optimal alternative of a number of alternatives with certain criteria. The essence of MADM is to determine the weight for each attribute, then proceed with the process of fixation that will solve the alternatives already given ".

2.2. Definition of school

School could be viewed into the tiered and continuous education unit to organize teaching and learning activities [3-4]. Schools can also be interpreted as institutions in which there are teachers, students, and administrative staff who have their respective duties in expediting the program [49-51].

In addition, the particular significance to look into the entire school refers to expand the basic role of institution or organization authorized to organize learning activities [52-54]. The wide range of skills might need to obtain the special attribution in aiming to produce the outcome with good knowledge and attitude [55-57]. Moreover, such components become a main priority among the schooling programs in deliberating the continuing schools to expand the skills [58-60]. As a result, the stage of achieving the abilities in consulting the potential value to train needs to gather continuing programs with higher level of work assigned into their skills [61].

2.3. Decision support system criteria

Decision support systems are designed specifically to support someone who must make certain decisions [51-52]. Here are some criteria of decision support systems:

1) Interactive

Decision support system has a communicative user interface, so users can access quickly and obtain the information needed.

2) Flexible

A decision-support system has as many as possible a variable input, the ability to process and deliver outsourcing the decision alternatives to the user.

3) Quality Data

A decision-support system has the ability to receive a quantifiable quantity that is objective in nature from the wearer, as an entity for the processing of data.

4) Expert procedure

The decision support system contains a planned procedure based on a formal or a group's or a group's expertise in solving a problem with a particular phenomenon.

2.4. Resolution steps

The steps of settlement in using the SAW method could be viewed into the following [52]:

1) Determine the criteria that will be used as a reference in decision making, namely Ci.
2) Determine the match rating of each alternative on each criterion.
3) Make a decision matrix based on criterion (Ci), then do the normalization of matrix based on equation which is adjusted to attribute type (gain attribute and cost attribute) so obtained normalized matrix R.
4) The final result is obtained from each ranking process that is the sum of normalized matrix multiplication R with weight vector to obtain the largest value chosen as the best alternative (Ai) as solution.

3. Methodologies

3.1. Data collection

Data collection is an activity to find data field that will be used to answer research problem .

a) Library study

Library study is an activity of collecting data and information from various sources, such as books containing various kinds of theoretical studies that are needed by researchers, magazines, texts, historical stories, and documents.

b) Observation

Often observations are interpreted as a narrow activity, ie paying attention only to the naked eye.

3.2. Data analysis

Simple Additive Weighting (SAW) is one of the most popular methods used in Decision Support Systems. Selection of criteria for cases to be solved with the help of Decision Support System requires sharpening that is closely related to the problems at hand. Things that become the reference for choosing the criteria should have a strong urgency with the problem to be sought solution. The number of criteria taken to analyze no definite provisions, but the more variations of criteria selected the better the results will be obtained.

The SAW method or often also known as the weighted summing method is looking for weighted sums of performance twigs on each alternative on all attributes [50-51]. The SAW method requires the process of normalizing the decision matrix (X) to a scale comparable to all existing alternative ratings.

In the SAW method, criteria are perceived as benefit and cost criteria. Category criteria benefit or profit, if the criteria have a greater value then the better, while the criteria cost or cost the smaller the value then the better. Large and small values are seen from the relationship with the problems analyzed.

$$r_{ij} = \frac{x_{ij}}{max_{(xij)}} j \text{ is benefit attribute} \quad (1)$$

$$r_{ij} = \frac{min_{xij}}{x_{ij}} j \text{ is cost attribute} \quad (2)$$

Notes

rij = normalized performance rating score

xij = attribute value of each criterion

Max xij = the greatest value of each criteria

Max xij = the smallest value of each criteria

Benefit = if the greatest value is best

Cost = if the smallest value is best

where rij is a performance twig i=1,2,3,…,m dan j= 1,2,3,…,m. Alternative preference values (vi) as :

$$v_i = \sum_j^n = 1^{wjrij} \quad (3)$$

Notes :

V_I =ranking for any alternative

W_j = value bobot criteria

Rij= normalized performance rating score

A larger V value indicates that Ai's alternatives are preferred.

4. Implementation

4.1. Criteria and weight

In this study, there are weights and criteria needed to determine which university will be selected as the best university. Table 1 shows criteria, table 2 shows weight value, table 3 shows academic achievement (C1), table 4 shows master lecturer (C2), table 5 shows extracurricular (C3), table 6 shows accreditation status (C4), table 7 shows facilities (C5), and table 8 shows scholarship (C6).

Table 1: Criteria

Criteria	State	Score
C1	Academic achievement	20
C2	Master Lecturer	15
C3	Extracurricular	15
C4	Accreditation Status	10
C5	Facilities	20
C6	Scholarship	20
		100

Alternative:

A1=ATP

A2=STMIK Pringsewu

A3=STIE

A4=STKIP

A5= STIT

Table 2: Weight Value

Weight	Score
Very Low	1
Low	2
Adequate	3
High	4
Very high	5

Table 3: Academic Achievement (C1)

Academic Achievement	Weight	Score
Not important	SR	1
Very Not important	R	2
Important	C	3
Very important	ST	5

Table 4: Master Lecturer (C2)

Master Lecturer	Weight	Score
Not important	SR	1
Very Not important	R	2
Important	T	4
Very important	ST	5

Table 5: Extracurricular (C3)

Extracurricular	Weight	Score
Not important	SR	1
Important	T	4
Very important	ST	5

Table 6: Accreditation Status (C4)

Accreditation Status	Weight	Score
Not important	SR	1
Important	C	3
Very important	ST	5

Table 7: Facilities (C5)

Facilities	Weight	Score
Very Not important	SR	1
Not important	R	2
Important	C	3
Very important	ST	5

Table 8: Scholarship (C6)

Scholarship	Weight	Score
Very Not important	SR	1
Not important	R	2
Important	T	4

Very important	ST	5

Specifies each alternative's match rating on each criteria. The alternative match rate data is as shown in Table 9.

Table 9: Alternative Match Rating on Each Criteria

No	Alternative	Criteria					
		Academic achievement	MasterLecturer	Extracurricular	Accreditation Status	Facilities	Scholarship
1	ATP	3	2	4	4	2	4
2	STMIK	5	4	4	4	2	2
3	STIE	1	5	1	1	5	4
4	STKIP	2	2	3	3	2	4
5	STIT	3	4	4	1	2	3

Based on table 9 is converted into X decision matrix with data:

$$X = \begin{Bmatrix} 3 & 2 & 4 & 1 & 2 & 4 \\ 5 & 4 & 4 & 5 & 2 & 2 \\ 1 & 5 & 1 & 3 & 5 & 4 \\ 2 & 2 & 3 & 3 & 2 & 4 \\ 3 & 4 & 4 & 1 & 2 & 2 \end{Bmatrix}$$

4.2. Matrix normalization

- A1

$$R_1 = \frac{3}{\max\{2;4;5;2;4\}} = \frac{2}{5} = 0{,}6$$

$$R_2 = \frac{2}{\max\{2;4;5;2;4\}} = \frac{2}{5} = 0{,}4$$

$$R_3 = \frac{4}{\max\{4;4;1;3;4\}} = \frac{4}{4} = 1$$

$$R_4 = \frac{1}{\max\{1;5;3;3;1\}} = \frac{1}{5} = 0{,}2$$

$$R_5 = \frac{2}{\max\{2;2;5;2;2\}} = \frac{2}{5} = 0{,}4$$

$$R_6 = \frac{4}{\max\{4;2;4;4;4\}} = \frac{4}{4} = 1$$

- A2

$$R_{11} = \frac{5}{\max\{3;5;1;2;3\}} = \frac{5}{5} = 1$$

$$R_{12} = \frac{4}{\max\{2;4;5;2;4\}} = \frac{4}{5} = 0{,}8$$

$$R_{13} = \frac{4}{\max\{4;4;1;3;4\}} = \frac{4}{4} = 1$$

$$R_{14} = \frac{5}{\max\{1;5;3;3;1\}} = \frac{5}{5} = 1$$

$$R_{15} = \frac{2}{\max\{2;2;5;2;2\}} = \frac{2}{5} = 0{,}4$$

$$R_{16} = \frac{2}{\max\{4;2;4;4;3\}} = \frac{2}{4} = 0{,}5$$

- A3

$$R_{21} = \frac{1}{\max\{3;5;1;2;3\}} = \frac{1}{5} = 0{,}2$$

$$R_{22} = \frac{5}{\max\{2;4;5;2;4\}} = \frac{5}{5} = 1$$

$$R_{23} = \frac{1}{\max\{4;4;1;3;4\}} = \frac{1}{5} = 0{,}25$$

$$R_{24} = \frac{3}{\max\{1;5;3;3;1\}} = \frac{3}{5} = 0{,}6$$

$$R_{25} = \frac{5}{\max\{2;2;5;2;2\}} = \frac{5}{5} = 1$$

$$R_{26} = \frac{4}{\max\{4;2;4;4;3\}} = \frac{4}{4} = 1$$

- A4

$$R_{31} = \frac{2}{\max\{3;5;1;2;3\}} = \frac{2}{5} = 0{,}4$$

$$R_{32} = \frac{2}{\max\{2;4;5;2;4\}} = \frac{2}{5} = 0{,}4$$

$$R_{33} = \frac{3}{\max\{4;4;1;3;4\}} = \frac{3}{5} = 0{,}75$$

$$R_{34} = \frac{3}{\max\{1;5;3;3;1\}} = \frac{3}{5} = 0{,}6$$

$$R_{35} = \frac{2}{\max\{2;2;5;2;2\}} = \frac{2}{5} = 0{,}4$$

$$R_{36} = \frac{4}{\max\{4;2;3;4;3\}} = \frac{4}{4} = 1$$

- A5

$$R_{41} = \frac{4}{\max\{3;5;1;2;3\}} = \frac{1}{5} = 0{,}6$$

$$R_{42} = \frac{4}{\max\{2;4;5;2;4\}} = \frac{4}{5} = 0{,}8$$

$$R_{43} = \frac{4}{\max\{4;4;1;3;4\}} = \frac{4}{4} = 1$$

$$R_{44} = \frac{1}{\max\{1;5;3;3;1\}} = \frac{1}{5} = 0{,}2$$

$$R_{45} = \frac{2}{\max\{2;2;5;2;2\}} = \frac{2}{5} = 0{,}4$$

$$R_{46} = \frac{3}{\max\{4;2;4;4;3\}} = \frac{3}{4} = 0{,}75$$

From the above calculation, then obtained normalized matrix as follows:

$$r_{ij} = \begin{Bmatrix} 0{,}6 & 0{,}4 & 1 & 0{,}2 & 0{,}4 & 1 \\ 1 & 0{,}8 & 1 & 1 & 0{,}4 & 0{,}5 \\ 0{,}2 & 1 & 0{,}25 & 0{,}6 & 1 & 1 \\ 0{,}4 & 0{,}4 & 0{,}75 & 0{,}6 & 0{,}4 & 1 \\ 0{,}6 & 0{,}8 & 1 & 0{,}2 & 0{,}4 & 0{,}75 \end{Bmatrix}$$

4.3. Calculation

$V_I \sum_{j=1}^{n} W_j \quad r_{ij}$

V1 = {(0, 6 x 20) + (0, 4 x 15) + (1 x 15) + (0, 2 x 10) + (0, 4 x 20) + (1 x 20)} = 63

V2 = {(1 x 20) + (0, 8 x 15) + (1 x 15) + (1 x 10) + (0, 4 x 20) + (0, 5 x 20)} = 75

V3 = {(0, 2 x 20) + (1 x 15) + (0, 25 x 15) + (0, 6 x 10) + (1 x 20) + (1 x 20)} = 68, 75

V4 = {(0, 4 x 20) + (0, 4 x 15) + (0, 75 x 15) + (0, 6 x 10) + (0, 4 x 20) + (1 x 20)} = 59, 25

V5 = {(0, 6 x 20) + (0, 8 x 15) + (1 x 15) + (0, 2 x 10) + (0, 4 x 20) + (0, 75 x 20)} = 64

From the above calculation obtained the largest value on A2 so that the best alternative in other words STMIK Pringsewu is the best college.

5. Conclusion

Based on the results of design, implementation, and testing that have been done in the previous section, then in this study can be drawn conclusion: 1) Application of Simple Additive Weighting Method (SAW) is able to provide recommendation to user in the form of Higher Education based on the weight of predetermined criteria. 2) Simple Additive Weighting (SAW) method can be used to solve problems The selection of universities with the calculation of the method found that the most prioritized criteria are Accreditation compared to the other nine criteria such as academic achievement, non-academic achievement, overseas cooperation, domestic cooperation, Master lecturer, number of doctoral lecturer, lab facilities and scholarships.

Based on the results of research, there are some suggestions that the authors propose to develop this system more widely better as follows: 1) In solving multi criteria problem Simple Additive Weighting (SAW) method is not the only decision-making method that can be used, it is better to try to use other method or can combine two methods to support more effective decision. 2) Can be added other data that support the selection of colleges such as the addition of criteria. 3) To simplify and speed up the decision-making process, it is best to use the computer application.

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